I-680 Smart Lane Project

Electronic Toll System Requirements

November 2006

Contents

1. PURPOSE OF THIS DOCUMENT

The purpose of this document is to describe the functional I-680 Southbound Smart Lane (Smart Lane) electronic toll system (ETS) requirements, various operating business rules, and interfaces to other external systems. This document will be reviewed and approved by Alameda County Congestion Management Agency (ACCMA) staff on behalf of the Sunol Smart Carpool Lane Joint Powers Authority (JPA) and will be used as the basis for developing the ETS Request for Proposals (RFP) document to procure the ETS for the Smart Lane facility. In addition, the requirements presented herein will be used as the basis for the validation of the designed, developed and delivered ETS. Any future changes and/or additions made to these requirements must also be approved by ACCMA staff prior to their inclusion in this document.

2. DEFINITIONS, ACRONYMS AND ABBREVIATIONS

ACCMA	Alameda County Congestion Management Agency
AVI	Automatic Vehicle Identification
AVC	Automatic Vehicle Classification
BATA	Bay Area Toll Authority
Caltrans	California Department of Transportation
CCTV	Closed Circuit Television
CHP	California Highway Patrol
CSR	Customer Service Representative
CTOC	California Toll Operators Committee
DMS	Dynamic Message Sign
DRDS	Dynamic Rate Display Sign
DSRC	Dedicated Short Range Communications
ED	Executive Director
ETC	Electronic Toll Collection
ETS	Electronic Toll System
FasTrak™	FasTrak™ is the Electronic Tolling System that is utilized in California
FIFO	First In First Out
FMAS	Facility Management and Accounting System
GUI	Graphic User Interface
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
ITS	Intelligent Transportation System
Integrator	ETS Contractor
JPA	Sunol Smart Carpool Lane Joint Powers Authority

LED	Light Emitting Diode (LED)
LOS	Level of Service
MER	Mobile Enforcement Reader
MF	Mixed Flow
MOMS	Maintenance Online Management System
NTCIP	National Transportation Communications for ITS Protocol
PDA	Personal Digital Assistant
RCSC	Regional Customer Service Center
RTMS	Remote Traffic Microwave Sensor
RFID	Radio Frequency Identification
RF	Radio Frequency
SOV	Single Occupancy Vehicle
Tag	In-vehicle FasTrak™ Transponder
TCP/IP	Transmission Control Protocol/Internet Protocol
Title-21	This is the State-mandated standard that must be followed by every electronic tolling system deployed in California
TDC	Toll Data Center
Transponder	A small in-vehicle electronic device, used for the payment of tolls, which contains a unique identification number.
TMC	Traffic Management Center
UPS	Uninterruptible Power Supply
WAN	Wide Area Network

3. GENERAL OVERVIEW

3.1. GOALS OF THE SMART LANE SYSTEM

In order to provide better traffic flow on I-680 in Alameda and Santa Clara Counties, a southbound high occupancy vehicle (HOV) lane will be converted to a High Occupancy Toll (HOT) lane. The project limits are from just south of the State Route (SR) 84 Interchange near Pleasanton to just south of Calaveras Boulevard (SR 237) in Milpitas. The California Legislature under AB 2032 and the Federal Highway Administration (FHWA) authorized this conversion as a pilot project to improve travel efficiency in the corridor and provide more options to individual travelers. The ACCMA has been tasked and authorized to convert the existing HOV lane in the southbound direction into an HOT Lane. The ACCMA along with the Alameda County Transportation Improvement Authority (ACTIA) and the Santa Clara Valley Transportation Authority (VTA) has formed the Sunol Smart Carpool Lane Joint Powers Authority (JPA) to administer and operate the I-680 HOT lane. This conversion project is referred to as the Southbound I-680 Smart Carpool Lane (Smart Lane) Project. The California Department of Transportation (Caltrans) is responsible for the design and construction of the southbound I-680 standard HOV Lane. Through conversion of the HOV lane to a Smart Lane, the project will achieve the following goals:

1. Better utilize the HOV lane to improve traffic throughput in the corridor; and
2. Optimize this new revenue stream to help pay for transportation improvements and transit operations in the corridor.

3.2. METHOD OF TOLL COLLECTION

The toll collection system to be deployed on the Smart Lane will be fully electronic and utilize Dedicated Short Range Communications (DSRC) and Radio Frequency ID-based (RFID) Automatic Vehicle Identification (AVI) technology as the only method of payment. The tolling system shall be designed and developed to operate within the Title-21 requirements. This method of toll collection is known as Electronic Toll Collection (ETC). The ETC system to be deployed on the Smart Lane will be FasTrak™, which is the current standard in California. Single occupancy vehicle (SOV) operators will be required to obtain a FasTrak™ transponder, also commonly referred to as a tag, from the Bay Area Toll Authority (BATA).

In contrast to the current HOV system in use in Northern California that allows eligible HOVs to enter and exit at any point along the facility, the Smart Lane configuration will restrict access and only allow Smart Lane entry and exit at specific access points. The ETS will carefully track and record when a FasTrak™ transponder enters the Smart Lane in order to ensure that the appropriate toll is collected from the transponder carrying SOV drivers who choose to buy into the Smart Lane.

3.3 HOURS OF OPERATION

The Smart Lane shall operate 24 hours a day, 7 days a week, pending approval of the hours of operation of the HOV lane.

3.4. DIVISION OF SMART LANE RESPONSIBILITIES

3.4.1. Joint Powers Agency (JPA)

The JPA, as the owner of the Smart Lane infrastructure, will be responsible for the following:

1. Operation, monitoring, maintenance and technical support of the entire ETS, including: the FasTrak™ readers and antennas, the Dynamic Message Signs (DMS), tolling zone controllers, Vehicle Detection System (VDS) equipment, Closed Circuit Television (CCTV) equipment, the Smart Lane enforcement equipment that the California Highway Patrol (CHP) will utilize, all equipment and components related to the Smart Lane communications system, which shall include the links to BATA, Caltrans and the CHP vehicles and all ETS software;

2. The Smart Lane toll transaction and trip generation process, which shall be located at the Toll Data Center (TDC);

3. Tolling zone equipment control and monitoring;

4. TDC operations and maintenance;

5. Dynamic pricing, rate setting and toll rate management process;

6. Smart Lane Customer Service Center (CSR) functions, monitoring and audit;

7. Smart Lane financial reconciliation process with BATA;

8. Providing Smart Lane FasTrak™ reporting;

9. Monitoring the Smart Lane and/or the System Operator if the JPA chooses to second source the Smart Lane operations;

10. Perform lane and/or shoulder closures, with Caltrans's approval, in order to properly maintain and support the Smart Lane equipment and software;

11. Maintenance of the Smart Lane static signs and the highway lighting systems that are provided at the ingress and egress points;

12. Conduct Smart Lane specific marketing; and

13. Evaluation of the Smart Lane operation within 3 years of system opening.

Additional JPA Smart lane responsibilities are presented in the Joint Powers Agreement, which was executed on February 23, 3006.

3.4.2. Bay Area Toll Authority

BATA will be responsible for the following:

1. Full Regional Customer Service Center (RCSC) processing, including FasTrak™ account management, customer service interface to the public, Smart Lane trip record processing, revenue and data reciprocity with the other California Toll Operators Commission (CTOC) agencies, and all other revenue management functions;

2. Modifications to RCSC software to accommodate the Smart Lane FasTrak™ account statements and reporting requirements;

3. Manage FasTrak™ accounts, transponder inventory and tracking, and transponder fulfillment;

4. Operate, support and maintain FasTrak™ back office operations; and

5. Provide tag status file data, FasTrak™ revenue and account information to the JPA.

3.4.3. California Department of Transportation

Caltrans will be responsible for the following:

1. Safe operation of I-680;

2. Incident response management within the Southbound I-680 Sunol Corridor, including the Smart Lane;

3. Responsible for overriding the Smart Lane DMS messages, in coordination with JPA staff, if a situation arises which warrants an override of the ETS operation, as defined in the JPA/Caltrans Agreement;

4. Operation of a traffic monitoring system for the I-680 corridor; and

5. Roadway maintenance of the entire facility other than the Smart ETS and FasTrak™ equipment.

4. SMART LANE ELECTRONIC TOLL SYSTEM

4.1. TOLL DATA CENTER SYSTEM

1. The TDC shall function as the central and primary logical unit for the Smart Lane system.

2. The TDC shall interface with the following ETS components that comprise the Smart Lane system:

- 2A - Tolling zone lane controllers;
- 2B - Dynamic toll rate displays installed as part of each DMS;
- 2C - System enforcement equipment used by the CHP;
- 2D - The Caltrans TMC;
- 2E - The BATA RCSC;
- 2F - The JPA Smart Lane system operations center, including the CSR and System Operator workstations; and
- 2G - Other HOT Electronic Toll Systems in Alameda County.

4.1.1. Primary Functions of the TDC

4.1.1.1. Traffic Demand Pricing Calculation

1. The TDC shall periodically and dynamically calculate the toll rate based upon Smart Lane traffic speed and density information and Mixed Flow (MF) lane travel time data that are gathered from the VDSs installed approximately every mile along the 14-mile Smart Lane facility.

2. The traffic data shall be collected from the Smart Lane via electromagnetic loops that will be installed in the Smart Lane.

3. The standard Caltrans double loop configuration shall be used in the Smart Lane.

4. To ensure that toll revenue maximization assessment occurs and to effectively cover the entire roadway, Remote Traffic Microwave Sensor (RTMS) devices shall be installed on the outside roadway approximately every mile along the I-680 Smart Lane corridor. RTMS equipment shall be used to collect travel time data from the MF lanes and shall also be used as back-up for the Smart lane traffic density and speed information.

5. The TDC shall collect traffic density and travel time data at a minimum interval of every 15 seconds. However, the actual time interval of collection of this roadway vehicle data by the TDC shall be determined by the ETS Integrator (Integrator) during the system design phase of the ETS Project.

6. The period at which the TDC calculates the toll rate shall be a user-settable, table-driven parameter in the ETS. The specific calculation interval shall be initially set during the ETS design phase of the project, but the system shall provide the ability for the JPA Executive Director (ED), or his designee, to modify the parameter at any time in the future. The settings for the calculation shall be adjustable by authorized, non-technical persons.

7. The minimum and maximum toll rates shall also be system parameters and shall be set by the JPA.

8. The dynamic pricing method and calculation shall be formulated by the Integrator during the ETS design phase of the project using the algorithm parameters incorporated into the ETS RFP as a guideline.

9. The Integrator shall provide, at a minimum, the following:

- 9A - A dynamic, real-time, parameter-driven toll rate calculation program that successfully meters Smart Lane traffic demand and ensures that the HOV/Smart Lane maintains a LOS C/D;
- 9B - A toll rate calculation that accounts for traffic densities in the Smart Lane and vehicle travel times in the MF lanes;
- 9C - A toll rate calculation program that accounts for disparities in traffic densities occurring simultaneously throughout the entire length of the Smart Lane corridor;
- 9D - An interval of change for the toll rate (i.e. possibly every 5 minutes) that successfully controls Smart Lane demand without creating driver confusion by changing too frequently;
- 9E - An individual operator adjustable toll rate increment of $d.cc that successfully controls Smart Lane demand;
- 9F - A user settable minimum toll rate of $1.00; and
- 9G - A dynamic pricing structure that provides the ability to toll by segment.

4.1.1.2. Smart Lane Trip Assembly

1. The TDC shall be responsible for gathering and compiling vehicle, transponder, and toll rate data from all tolling zone lane controllers and creating individual trip revenue transaction records that shall eventually be sent to BATA for processing.

When a FasTrak™ transponder enters the Smart Lane and passes through a tolling zone, the transponder is detected by the antenna/reader and the lane controller verifies that the transponder is valid by comparing the transponder number to the tag status file that is resident in the lane controller's memory. Data, including the transponder number, date, time, tolling zone location of the transponder read, and the toll rate that was in effect when that vehicle entered the Smart Lane shall be sent to the TDC. This series of events occurs every time a vehicle that is equipped with a FasTrak™ transponder passes through a Smart Lane tolling zone. Therefore, if it is a through-trip, each time the vehicle traverses a tolling zone a distinct transaction record shall be generated.

2. If a transponder is detected but it is determined to be invalid, the lane controller shall send a command to illuminate the tolling zone beacon. The beacon shall illuminate within 0.1 seconds from the time in which the lane controller makes this determination. For each invalid transponder read a transaction record shall be developed by the lane controller and sent to the TDC for future use.

3. The TDC computer shall then compile each of the vehicle transaction records and event data collected throughout the specific vehicle trip and determine where the trip began, which segments were traveled, when the trip ended, and which toll should be charged.

4. The TDC shall then determine whether or not there is a more recent Smart Lane tolling zone transaction than the most recently received record by comparing the record times to indicate that the specific trip is now complete.

5. Based upon these internal calculations, the TDC shall then develop a Smart Lane trip record, store this record in the proper location and send the trip record to the BATA RCSC for posting to the FasTrak™ customer account and to collect the revenue associated with that Smart Lane trip. The TDC shall be designed to store Smart Lane trip records for at least 12 months.

6. The ETS shall include parameters that define the maximum duration for a single trip and logic that accounts for events such as a change in direction of travel or a communications failure with one or more tolling zone lane controllers.

7. The Smart Lane system shall be configured to charge one toll per trip, for example the toll rate that is displayed on the DMS as the vehicle enters the Smart Lane, but the ETS shall also include functionality that allows for segment-based tolling.

4.1.1.2.1 Toll Rate Safeguards

1. When a vehicle enters the Smart Lane, the toll rate might change between the time at which the driver views the toll rate on the DMS and the time at which the driver passes through the tolling zone. Based upon near real-time traffic density and speed data, the TDC shall calculate the amount of time it takes for a vehicle to view the toll rate and then pass through the tolling zone that is immediately downstream from the DMS that conveyed the toll rate to that vehicle operator. If the toll rate changes during that interval of time, the driver shall be charged the lesser of the two rates.

2. The TDC shall also include logic that accounts for DMS communication failures that result in the display of incorrect toll rates.

4.1.1.3. Smart Lane Trip Reconciliation

1. The TDC shall include Smart Lane trip audit and reconciliation functionality. It shall provide a secure user interface which will allow TDC personnel to view and reconcile Smart Lane trips and revenue data. The interface shall also include reporting capabilities that allow users to create, execute, and store reports.

2. The interface shall provide detailed transaction data such as tag-read times and locations, toll rate data, and other supporting raw transaction information. This information shall then be used to verify that trips were properly created and can be reconciled.

3. The interface shall allow authorized users to make adjustments to the data and correct errors in compiled revenue bearing trips. Users shall be able to adjust individual transactions or bulk sets of transactions if it is determined that a Smart Lane trip needs to be developed and/or modified.

4. The TDC database shall store configurable audit parameters, and provide a permanent audit record, or trail, of any adjustments that are made to summary or detail information.

4.1.1.4. Tolling Zone Operation Monitoring

1. The TDC shall include a secure, web-based monitoring interface that shall allow authorized users to view raw and summarized transaction and event data, as it occurs in real-time, at each tolling zone.

2. The tolling zone lane controllers shall broadcast data in near real-time to the TDC and this data shall be compiled and displayed in an easily understood, graphical manner.

3. Presented below is typical example data:

- 3A - Last 10 transponder reads;
- 3B - Transponder and/or traffic volume during the last 15 minutes, last 30 minutes, last hour, since 6:00 a.m., etc;
- 3C - Discrete messages and events from the roadside equipment, including
  - 3Ca - Transponder Identification (ID);
  - 3Cb - Transponder read time;
  - 3Cc - Transponder handshakes (the number of times during vehicle passage through a tolling zone that the transponder and the antenna communicate with one another);
  - 3Cd - Vehicle speed;
  - 3Ce - Traffic density on a particular segment;
  - 3Cf - Travel time data in the MF lanes;
  - 3Cg - Roadside equipment events;
  - 3Ch - VDS equipment events;
  - 3Ci - DMS events; etc.

4. The interface shall support JPA defined user roles, which includes providing different sets of data to different user categories. The interface is intended for use by CSRs, operations staff and maintenance personnel.

5. The interface shall protect customer information and operate under the requirements of California State privacy legislation.

4.1.1.5. TDC Reporting

1. The TDC shall provide a fully integrated reporting module to support trip generation and reconciliation, Smart Lane operations and JPA managerial system monitoring requirements.

2. The module shall include predefined traffic, revenue and CSR audit reports as well as support for ad hoc reporting needs.

3. The reporting system shall allow users to browse, choose, and run reports through a clearly displayed and user-friendly Graphical User Interface (GUI).

4. The reporting interface shall allow users to schedule reports to be run in the future.

5. The reporting interface shall allow reports to be output, saved, or printed in at least the following formats:

- 5A - On-screen;
- 5B - PDF;

- 5C - HTML; and
- 5D - Excel.

6. When accessing or running reports, the execute-to-display or execute-to-print time shall be less than one minute for each request.

7. The TDC report server shall be operational and available 24 hours per day, seven days a week.

8. Presented below is a list, at a minimum, of the required sample TDC reports:

- 8A - Smart Lane Revenue Report;
- 8B - Smart Lane Traffic Report (by segment and entire facility);
- 8C - Smart Lane Trip Posting (to BATA) Report;
- 8D - BATA Smart Lane Trip Reconciliation Report;
- 8E - Transaction and Trip Adjustment Report;
- 8F - Tolling Zone History Report;
- 8G - Detailed FasTrak™ Transaction Report;
- 8H - CSR Audit Report;
- 8I - Toll Rate Change Tables by Tolling Zone;
- 8J - Smart Lane Travel Time Report (be segment and by facility);
- 8K - MF Lane Travel Time Report (by segment and by facility);
- 8L - Equipment Maintenance Reports; etc.

4.1.1.6. Data Transmission

1. Data transmissions originating from the TDC shall occur automatically and utilize guaranteed delivery protocol.

2. Data communication between the TDC and the Smart Lane website shall be via an Ethernet connection.

3. Data communication between the TDC and the BATA RCSC shall be via FTP for Smart Lane trip records to and from a pre-configured drop box.

4.1.1.7. TDC Security

1. The TDC shall securely maintain Smart Lane data through a standard login and password-based security system.

2. Secure user accounts shall be administered through a system administration interface.

3. The system shall operate under the provisions of all California State privacy laws. For example, customer data that is output for uses other than internal Smart Lane operations shall be masked to maintain customer privacy.

4. The database shall use security service enterprise authentication for connections to the database. This will centralize database security in one location.

5. All users shall have their own user name and password that is the same across all databases.

6. Users shall have individual resource usage limits set for them to prevent unauthorized or excessive utilization of system resources.

7. Profiles shall be used to define resource usage limits by work activity or job type.

8. Users shall be granted profiles according to their job needs.

9. The database shall be able to restrict data access down to the row level.

4.1.1.8. Receipt and Downloading of Tag Status Files

1. The TDC shall receive, at least once per day, updated tag status files from the BATA RCSC.

2. The file acquisition process shall adhere to the BATA Interface Control Document (ICD), a copy of which shall be presented in the appendices of the ETS RFP.

3. The TDC shall automatically, upon receipt of tag status data from BATA and integrating the files into the TDC database, download either the full or an incremental tag file to each of the three tolling zone lane controllers. The incremental tag status file download would include any new FasTrak™ accounts or changes to existing accounts.

4. The method of file download shall be according to the BATA RCSC ICD.

4.1.1.9. Mobile Enforcement Equipment Data Transmission

1. The TDC shall send tag status data to wireless on-board mobile enforcement equipment terminals to enable the CHP officers to enforce the Smart Lane.

2. This secure data communications application shall be hosted on a wireless network to enable enforcement vehicles to obtain the tag status file data in a real-time basis.

4.1.2. System to System Interfaces

1. The TDC shall be required to interface with three other systems to obtain data required for Smart Lane toll collection and operations.

2. The BATA RCSC shall be the single point in which Smart Lane toll trips shall be transferred for posting, which shall include debiting the toll charge from the FasTrak™ customer accounts. The TDC shall also receive tag status files from the RCSC on, at a minimum, a daily basis, reconciliation files and transaction files.

3. The TDC shall provide the Caltrans TMC with traffic density and speed data from the Smart Lane and travel time data from the MF lanes.

4. The incident detection process shall be the responsibility of Caltrans. In the event that an incident does occur that would require temporary suspension of the ETS and/or Smart Lane closure, this shall be accomplished via a command issued by the TMC Manager to the DMSs.

5. As part of the Smart Lane enforcement effort, the TDC shall also interface to the enforcement equipment that is provided to the CHP.

6. The TDC shall download the full CTOC tag status file at least once per day to the lane controllers, the MERs and the hand held enforcement devices. Incremental tag status file updates shall also be automatically sent from the TDC to the lane controllers and the enforcement equipment when they are received from the RCSC.

7. There will be incidents on southbound I-680 that may necessitate the closing of the Smart Lane or the diversion of MF traffic to the Smart Lane. These actions should only be taken by authorized Caltrans TMC staff, with input from the CHP and the JPA ED.

8. The TMC shall be included in the system network in order to facilitate emergency actions in the Smart Lane.

9. All actions taken by TMC personnel shall be logged into the Smart Lane TDC system database and reports generated that detail those actions.

4.1.3. Equipment Interfaces

4.1.3.1. Lane Controller

1. The TDC shall interface to each tolling zone lane controller via a real-time Ethernet connection.

2. The interface will support the transmission of raw vehicle, transponder, and event data. It will also support the transmission of daily incremental transponder status files and periodic toll rate data.

3. The interface shall be automatic and not require human intervention.

4. The interface control document will be developed by the vendor during the system design phase of the project.

4.1.3.2. Dynamic Message Sign Rate Display

1. The TDC shall interface with each DMS via a real-time data and communications connection.

2. The interface shall support the transmission of message data as well as system status requests and be NTCIP compliant.

3. The DMS Interface Control Document (ICD) shall be supplied by the vendor that is selected by the ETS Integrator.

4.1.4. TDC Location

1. The location of the TDC shall be in a secure and environmentally controlled area which will only be accessible to authorized personnel.

2. The specific location of the TDC shall be defined by JPA and will be presented in the ETS RFP.

4.1.5. TDC Hardware Requirements

1. The TDC system shall include the following equipment:

- 1A - Primary and back-up computers that shall provide the processing capabilities that are described in this document. The back-up TDC computer shall automatically assume primary operating capabilities when the primary unit experiences failure;
- 1B - Personal Computer (PC) based workstations that shall provide all necessary operating functions at the TDC;
- 1C - Printers that shall be used to generate FasTrak™ reports and other TDC based reports;
- 1D – Secured drop box, routers and other equipment to support the BATA RCSC file exchange process; and
- 1D - Other equipment that is necessary to support the TDC system.

4.1.6. TDC Operating Systems

1. The TDC shall operate on the most recent, stable release of Microsoft's Windows Server operating system, or equivalent, as approved by the JPA ED.

4.1.7. TDC Database Requirements

1. The requirements for the TDC database shall be consistent with the JPA preferences, currently assumed to be Oracle-based, and will store raw data from the tolling zones and compile detail and summary FasTrak™ transaction data.

2. To support the enforcement subsystem, it shall also serve as a repository for necessary tag status file data.

3. The database shall provide a certain amount of data online for users to access and archive older, less frequently needed data offline.

4. The online/archive storage limitations shall be accessible to approved users as editable system parameters.

5. The database shall store individual ETS events from the lane controllers installed at the tolling zones. Provided below is an example of this type of data:

5A - Tolling zone ID;
5B - Smart Lane Mode;
5C - Transponder read date and read time;
5D - Transaction, trip and event message ID;
5E - Transaction, trip and event message sequence number;
5F - Toll rate for each trip;
5G - Transponder ID;
5H - Transponder operating status;
5I - FasTrak™ reader status; and
5J - VDS equipment status.

6. The TDC database shall store summary and detail transaction information as shown below:

6A - Date;
6B - Time;
6C - Transponder number;
6D - Toll paid;
6E - Direction of travel;
6F - Tolling zones;
6G - Length of trip; and
6H - Posted date.

7. The database shall partition individual transactions into uniform data segments for consistent data access, reporting and query performance.

8. The database shall store information related to status or state changes in the lane controller.

9. A record shall be stored in the lane controller at some regular interval (i.e. every 5 minutes) or every time the state of the lane controller changes.

10. The database shall store summary information for each status segment.

11. The transaction database shall store information about the facility, tolling zones, toll rates, equipment statuses, and any other relevant data related to Smart Lane operations. Example data:

11A - Facility ID;
11B - Facility name;
11C - Facility description;
11D - Tolling zone ID;
11E - Tolling zone name;
11F - Tolling zone description;
11G - Toll rate schedule ID; and
11H - Toll rate effective date/time.

12. The database shall store information supporting the Maintenance Online Management System (MOMS) as described below:

12A - Equipment type;
12B - Equipment description
12C - Equipment manufacturer;
12D - Equipment model;
12E - Equipment cost;
12F - Equipment serial number;
12G - Date put in service;
12H - Projected service life; and
12I - Current status.

13. The database shall store information about the business day and business week.

14. The database shall store information about the 4 possible Smart Lane modes of operation, including:

- 14A - Closed to all traffic;
- 14B - Open to HOV traffic only;
- 14C - Open to HOV and SOV (with FasTrak™ transponders) traffic only; and
- 14D - Open to all traffic.

15. The database shall store information regarding equipment that experiences degradation of operations and failures. Example data:

15A - Fault type;
15B - Date and time of fault;
15C - Reporting employee ID;
15D - Work order number;
15E - Notification date and time;
15F - Repairing employee ID; and

15G - Date and time fault corrected.

16. The database shall store information regarding system utilization and overall Smart Lane system performance, including the Level of Service for each 5-minute interval throughout each 24-hour period.

17. The database shall store information about file uploads and downloads, transponder status files, VDS data files, etc.

18. The database shall retain 12 months of detailed data online and 2 years of summary data online.

4.2. DYNAMIC MESSAGE SIGNS

4.2.1. Primary DMS Functions

1. The DMS shall be located approximately ½-mile upstream from each entry point to the Smart Lane and shall be the primary method of informing the public of what the toll rate will be if SOVs choose to use the Smart Lane.

2. When the TDC trip processor calculates a toll rate for an entry point, the rate shall be communicated to the DMS controller utilizing the IP address for that DMS controller.

3. The DMS controller shall send the display message to the Light Emitting Diode (LED) panel.

4. The panel shall interrogate itself and report back to the sign controller that the requested message is being properly displayed.

5. The DMS controller shall then relay this information back to the trip processor, which is located at the TDC.

6. In addition to reporting what is being displayed on the sign at the time of the rate change, the DMS shall be polled by the TDC at regular intervals (at least every 30 seconds) and shall in turn poll the LED panel and return the message being displayed for confirmation that the correct rate is being displayed.

4.2.2. DMS Equipment Requirements

1. The DMS shall be consistent with the Caltrans approved signage program.

2. The DMS sign shall include both static and dynamic portions.

3. The Smart Lane DMSs shall combine static sign information panels with dynamic panels.
4. The static part of the DMSs shall include displayed information that never changes (the Smart Lane downstream exit points, restricted hours, FasTrak™ logo, etc.).

5. The dynamic portion of the DMS shall include an LED panel attached to the sign that shall display the dynamically changing toll rates. This panel shall consist of at least 6 characters (alpha numeric) that are at least 12 inches in height.

6. The panel shall include an automatic feature that measures the ambient light and adjusts the intensity of the LEDs to be visible under all light conditions (full sun to full dark). In order to minimize the "halo" effect of certain colors, the LED color shall be amber.

7. The LED panel shall also include the ability for the sign to report to the TDC what is being displayed by interrogating the sign pixels.

8. The DMS shall be managed by a sign controller which will be located either at roadside in a weather hardened enclosure or on the mounted sign.

9. The DMS controller shall communicate to the TDC's trip processor via a communications network utilizing the National Transportation Communications for ITS Protocol (NTCIP) standard sets or, if allowed by JPA, Transmission Control Protocol/Internet Protocol (TCP/IP).

10. The DMS controller shall have a unique IP address that identifies its location.

4.3. TOLLING ZONES

4.3.1. Tolling Zone Overview

1. A series of tolling zones along the southbound I-680 corridor shall be situated at each access point to the Smart Lane in order to detect FasTrak™ transponders and to monitor vehicles as they enter and travel through the Smart Lane.

2. The tolling zones shall be located just downstream from the Smart Lane entry ramp and span the Smart Lane.

3. Raw vehicle and transponder data shall be gathered at these tolling zones and shall be transmitted to the TDC subsystem, which shall compile the FasTrak™ transaction data and create Smart Lane toll trips.

4.3.1.1. Primary Tolling Zone Functions

1. The primary functions of the tolling zones shall be to:

- 1A - Identify and sequence vehicles through the payment zone;

- 1B - Search for and read transponders;
- 1C - Create raw vehicle, transponder, and status messages;
- 1D - Visually notify CHP officers of possible Smart Lane violators; and
- 1E - The ETS shall have the capability to charge different tolls to accommodate future traffic conditions or JPA policies.

2. In order to accomplish these primary tasks, the ETS at the tolling zones shall utilize the following equipment:

- 2A - A lane controller, which shall be an industrial Personal Computer (PC) that performs the logical functions required to create raw vehicle, transponder, and status messages and act as the central point for all of the tolling zone equipment;
- 2B - An RFID-based Automatic Vehicle Identification (AVI) system; and
- 2C - An enforcement beacon subsystem.

3. A number of supporting functions shall also be carried out by the tolling zone controller to successfully perform the primary functions required for Smart Lane operations.

4. The system shall be responsible for monitoring maintenance and self-diagnostic messages sent from the roadside hardware described above and reporting on any system and/or equipment degradations or failures.

5. The tolling zone controller shall also receive FasTrak™ transponder status files from the TDC, which are files created on a daily basis that designate each transponder in the FasTrak™ system as ‘good,’ ‘bad,’ ‘low balance,’ etc.

6. The tolling zone controller shall store and transmit raw FasTrak™ transaction data across an Ethernet connection to the TDC.

7. Although a tolling zone shall be located just south of every Smart Lane entry point, a toll-paying customer shall only be required to pay one toll for each trip, regardless of the length or duration.

8. The TDC shall identify when a vehicle enters the Smart Lane system and only create one record for each individual trip.

4.3.1.2. Tolling Zone Locations

1. Each tolling zone shall be located on the downstream side of its respective Smart Lane entry point and each location shall consist of one set of the ETS equipment that is described above, as well as all necessary supporting equipment including cabling, uninterruptible power supply (UPS) devices, equipment enclosures, etc.

2. The method of toll collection shall ensure that traffic flow is not impeded and vehicles may travel through the tolling zone at speeds consistent with LOS C/D.

3. Since the Smart Lane system only consists of one lane of traffic, each vehicle shall be required to pass through the tolling zone at every entry point they encounter.

4.3.2. Lane Controller

1. The tolling zone lane controller shall control and monitor the toll collection activities at each tolling zone and be primarily responsible for gathering FasTrak™ transaction data and transmitting that information to the TDC, in a secure environment, and without duplication, for trip compilation.

2. The lane controller shall also interface with the TDC to receive daily FasTrak™ tag account status files on, at least, a daily basis.

4.3.2.1 Lane Controller Primary Functions

1. The primary functions of the ETS lane controller shall be to:

- 1A - Create and transmit vehicle count and transponder read data;
- 1B - Provide visual feedback of possible violations, through the use of an enforcement beacon installed at the tolling zone in such a position that it can be easily viewed by CHP officers;
- 1C - Monitor its peripheral tolling zone equipment (i.e. FasTrak™ reader, antenna, vehicle detection system equipment, etc) and report on the status of these pieces of equipment; and
- 1D - Receive daily transponder account status update files from the TDC.

2. The lane controller shall accommodate a system administration and maintenance interface. This interface shall be used by operations and maintenance personnel to accomplish tasks such as modifying system configuration files, extracting transaction data, performing preventive maintenance tasks, etc.

3. The lane controller shall be capable of storing no less than 30 days of vehicle, event and FasTrak™ transaction data.

4. The lane controller shall store no less than 10 million FasTrak™ transponder account status data.

5. All lane controller messages (i.e. vehicle, event, FasTrak™ transaction, maintenance, etc.) shall contain a unique sequence number.

6. The lane controller shall include at least the following information in the transaction record:

- 6A - Transponder number;
- 6B - Transponder status;
- 6C - FasTrak™ transaction date;
- 6D - FasTrak™ transaction time;
- 6E - Transponder handshake count;
- 6F - Lane controller date;
- 6G - Lane controller time;
- 6H - All pertinent VDS data; and
- 6I - Equipment states.

7. The lane controller's vehicle sequencing logic shall be self-correcting.

8. The lane controller shall record all transponders that are read by the FasTrak™ tolling zone subsystem.

9. The lane controller shall be able to operate normally without network communications, storing current records for later transmission to the TDC.

4.3.2.1.1. Equipment Monitoring and Control

1. The lane controller shall monitor the following peripheral equipment through real-time data connections:

- 1A - Vehicle detection system equipment;
- 1B - FasTrak™ transponder reader;
- 1C - FasTrak™ antennas;
- 1D - Enforcement beacon; and
- 1E - All other power supply and communications equipment that is located at the tolling zone.

2. The system monitoring functionality shall include the ability to receive maintenance status messages from all subsystems and it shall incorporate logical processes, local to the lane controller, which evaluate operations and create maintenance alerts based upon sets of rules and expected conditions.

3. The maintenance alerts that are generated by the lane controller shall be sent to the MOMS.

4. The MOMS shall be responsible for compiling the raw maintenance data into a database and creating maintenance alerts and work orders that define actual maintenance events that need to be addressed.

4.3.2.1.2. Lane Controller Data and File Transmission

1. The Smart lane controllers shall be connected to the TDC through an Ethernet connection and transmit files to the TDC server in real-time.

2. The lane controller shall transmit vehicle detection information, FasTrak™ transaction data, equipment diagnostics and maintenance data.

3. The lane controllers shall receive, at a minimum, daily FasTrak™ tag account status update files, system configuration files, and toll rate files.

4. The lane controller's serial ports shall be configurable as either RS-232 or RS-422.

5. Serial communications interfaces shall provide for error detection protocols.

4.3.2.2. Lane Controller Equipment Requirements

Under normal conditions, the lane controller shall operate in an automated fashion without intervention from operational personnel.

1. All ETS functions, including but not limited to, transaction assembly, file transmission, and toll rate assignment shall be designed to function independent of human interaction.

2. The lane controller shall be environmentally hardened and housed in an environmentally shielded and controlled enclosure to operate under the weather conditions found in the Bay Area.

3. The lane controller shall be designed with discrete input and output signal lines and use optical isolation circuitry for protection.

4. The lane controller shall store data redundantly.

5. The lane controller shall provide for a local user interface for maintenance purposes.

6. The lane controller data storage process shall be based on First in First out (FIFO) technology.

7. The lane controller performance shall be ample to handle all lane processes as designed at a rate of 2,500 vehicles per lane per hour, with 50% of those vehicles having transponders.

8. For any 10 second period, the lane controller shall be capable of handling all Smart Lane processes for transponder vehicle passage rates of 7,200 vehicles per lane per hour, assuming that all vehicles have transponders.

9. The tolling zone system shall capture transponder reads for 99.98% of the vehicles with properly mounted transponders passing through the tolling zone.

10. The tolling zone system shall capture transponder reads for less than 0.01% of the transponders traveling in the MF lane closest to the Smart Lane (leftmost MF lane).

11. The tolling zone system shall be capable of determining the direction of travel for all vehicles in the Smart Lane with an error rate in the determination of travel direction of no more than 0.01%.

4.3.2.3. Lane Controller Operating System

1. The lane controller Operating System (OS) shall be robust enough to support all of the operations of the tolling zone subsystems while meeting all of the requirements stated in the RFP.

2. The OS of the lane controller shall function in such a way that it allows for the real-time collection and transmission of data across an Ethernet network as well as remote, real-time user connections (for maintenance purposes).

3. The lane controller shall provide TCP/IP network support and TCP utilities such as telnet, ping, and FTP.

4.3.2.4. Lane Controller Interface to the Toll Data Center

1. Each lane controller shall maintain a real-time interface with the TDC. This interface shall allow for the transmission and reception, in real-time, of any data collected and assembled in the lane and any data compiled at the TDC which is necessary for tolling zone subsystem operations.

2. The lane controller to TDC interface shall be fully automated and not require human intervention.

3. The lane controller shall broadcast lane events in near real-time to the TDC to support the monitoring activities carried out by operations or maintenance personnel.

4. The lane controller shall transmit a periodic heartbeat, or status, message to the TDC.

5. If communication between the lane controller and the TDC fails, the lane controller shall periodically attempt to re-establish the connection until the connection is made.

6. The lane controller shall periodically (at least daily) receive tag status files from the TDC. Upon receiving tag status files from the TDC, the lane controller software shall subject the file to various sanity checks to ensure that the file is valid prior to integrating the new file into its static memory. Typical sanity checks would include checking the file type, the file size, the file header and footer data, etc.

7. The lane controller shall transmit an indicator of TDC-initiated command execution, for example transmission is successful, it has failed, etc.

4.3.2.5. Lane Controller Equipment Interface

1. All lane controller interfaces to peripheral equipment shall incorporate means of detecting whether the equipment is operating properly or if it experiences malfunction.

4.3.2.5.1. Lane Controller Interface to the Vehicle Detection Systems

1. The interface between the lane controller and the VDS equipment, at those locations in which this communications link is established, shall be in real-time.

2. The VDS data that is gathered shall consist of vehicle speed and traffic volume data (from the Smart Lane) and travel time information from the MF lanes. The necessity of the accurate and timely exchange of data between the two systems is essential to successful dynamic pricing operations.

4.3.2.5.2. Lane Controller Interface to the FasTrak™ Reader

1. The interface between the lane controller and the FasTrak™ transponder reader shall be in real-time and not be encumbered by latency.

2. The bidirectional interface shall allow for the exchange of lane controller commands and FasTrak™ system transponder data. The necessity of the accurate and timely exchange of data between the two systems is essential to successful ETS operations.

4.3.2.5.3. Lane Controller Interface to the Enforcement Beacon

1. The lane controller shall interface with the tolling zone enforcement beacon in real-time and immediately send the proper commands to the beacon when a valid FasTrak™ transponder is processed.

4.3.2.5.4. Uninterruptible Power Supply

1. The lane controller shall interface with a UPS to ensure that battery power back-up is available to the controller if commercial power fails.

2. The use of UPS equipment shall also ensure that the lane controller software is shut down in an orderly fashion if commercial power is not restored prior to the UPS battery power running out.

4.3.3. Vehicle Detection System Equipment

4.3.3.1. VDS Equipment to be Deployed

1. The primary functions of the VDS equipment shall be to accurately and in near real-time detect vehicles in the Smart Lane to determine the traffic density and the speed of vehicles that are traveling in that lane.

2. Inductive loops shall be installed along the Smart Lane, approximately one mile apart. Double loops shall be installed according to the most currently available Caltrans loop installation standard.

3. Remote Traffic Microwave Sensor (RTMS) devices shall be installed, on the outside shoulder, and shall collect travel time data from vehicles that are traveling in the MF lanes. RTMS devices are miniature radar units, which operate in either of two microwave bands, and transmit a low-power microwave signal of constantly varying frequency in a fixed fan-shaped beam.

4. The RTMS subsystems shall also be used as back-up in collecting traffic speed and density data from the Smart Lane if the loops experience failure.

4.3.3.2. VDS Equipment Requirements

1. The VDS equipment shall function independently of the lane controller and send raw traffic data that shall be compiled by the lane controller.

2. The VDS shall include functionality that allows for a direct maintenance data connection, both locally and remotely.

3. The VDS equipment shall detect and sequence all vehicles that pass through a focused point with an accuracy of at least 99.9% accuracy in all weather conditions.

4. The VDS equipment shall provide self-diagnostic and fault detection messages to the lane controller.

5. The VDS equipment shall detect and calculate the speed and density of vehicles traveling no less than six inches apart in the Smart lane at the above described accuracy rate.

4.3.4. FasTrak™ Reader and Antenna

4.3.4.1. Primary Functions of the FasTrak™ Reader and Antenna

1. The FasTrak™ reader, and its peripheral equipment including the antenna, shall accomplish the primary functions of transponder detection and reporting process.

2. The reader's state, for example whether the RF module searches for transponders or not, shall be determined by the lane controller.

3. The FasTrak™ reader and antenna shall operate within the technical requirements presented in the Title-21 specifications.

4.3.4.2 Reader and Antenna Equipment Requirements

1. The FasTrak™ transponder reader and antenna shall be compatible and interoperable with all other electronic tolling systems that are deployed in California by complying with all operating and configuration requirements presented in the Title-21 specification.

2. As transponders are detected when they travel through the tolling zone, status indicator beeps shall sound in exactly the same manner that they do on other Bay Area FasTrak™ facilities.

3. The reader/antenna shall be required to read a transponder mounted inside a vehicle traveling at highway speeds from 0 to 100 miles per hour.

4. The reader shall transmit date, time, and tolling zone location data back to the transponder for possible future use.

5. The reader shall have incorporated functionality that ensures only transponders in the Smart Lane are read and transponders in the adjacent MF lanes are not read.

6. Algorithms that are used by either the reader or the lane controller shall be used to filter out improper cross-lane transponder reads.

7. FasTrak™ antennas shall be installed over the middle of the Smart Lane and shall be capable of reading transponders that are installed either on the windshield behind the rear-view mirror or on the lower left portion of the windshield (approximately 2 inches from the bottom and 2 inches from the edge).

8. The reader shall not be located more than 75 feet from the overhead mounted antenna.

9. The AVI system shall record transponders with an accuracy of at least 99.98%.

4.3.5. Tolling Zone Beacon

4.3.5.1. Primary Functions of the Tolling Zone Beacon

1. The primary function of the enforcement beacon shall be to visually alert CHP officers to the presence of a potential Smart Lane violator in the tolling zone.

2. The beacon shall have the illumination capability to provide visual feedback to CHP officers that are located within 100 feet of the beacon.

3. The beacon shall be located to allow vehicle operators that are traveling through the tolling zone to also see the device illuminate while maintaining a safe vehicle operating environment.

4.3.5.2. Beacon Equipment Requirements

1. The tolling zone beacons shall provide a visual signal and be directly controlled by the lane controller.

2. The beacons shall be installed at the tolling zone in such a location that allows it to be seen by CHP officers and motorists that are driving through the tolling zone.

4.4 VEHICLE DETECTION STATIONS

1. As described in Section 4.3.3, the VDS equipment shall be deployed to measure real-time traffic flow and vehicle speed and serve as input into the dynamic setting of tolls for Smart Lane usage.

2. VDSs shall collect the current traffic volume, and speed data from specific roadway sections that are noted in the preliminary design plans. This information shall be transmitted to the TDC which will be located at the JPA facility for analysis and dynamic pricing applications.

4.4.1. VDS Locations

1. An analysis was conducted to determine the appropriate ingress and egress locations which in turn helped to determine the location of the VDS equipment.

2. Inductive loops shall be installed in the Smart Lane and RTMS devices shall be installed on the roadway outside shoulder.

3. Loops shall collect traffic volume and speed data from the Smart Lane and the RTMS devices shall collect traffic data from the MF lanes which shall be utilized by the TDC to develop travel time data.

4.4.2. VDS Equipment Requirements

1. The VDS equipment shall be installed in standard Caltrans cabinets as indicated in the preliminary plans.

2. The VDS equipment shall be designed and operate in accordance with all current Caltrans specifications.

3. The VDS equipment shall be installed with a Model 170E Controller, which is the Caltrans standard for such equipment.

4.4.3. VDS Installation Requirements

1. The VDS controller cabinets shall be installed along the roadway adjacent to corresponding vehicle detection loops.

2. Cabinets shall be easily accessible from the ramp and/or the mainline by maintenance and operations personnel.

3. The cabinet locations shall be protected from traffic by placing them behind a guardrail or other similarly protected area.

4. The cabinets shall also be placed out of the flood plain and above the water level.

5. The loop detectors and RTMS devices shall be installed in accordance with standard Caltrans practice.

4.4.4. Interface to Caltrans Traffic Management Center

1. The VDS data shall be sent to the Caltrans TMC, via the TDC communications link, for operational use by Caltrans.

2. The TDC shall also have a direct communications link to the TMC to allow Caltrans staff to issue messages for display on the DMSs if incidents occur that warrant Caltrans control of the Smart Lane operation.

3. The JPA ED shall also be part of the decision making process when incidents occur that require Caltrans TMC intervention.

4.5. CLOSED CIRCUIT TELEVISION CAMERAS

1. Closed Circuit Television (CCTV) cameras shall be deployed for traffic condition surveillance, monitoring of the tolling zones and for safety reasons.

2. CCTV cameras shall also be used to assist Caltrans staff in detecting incidents and to track the progress of incident response and clearance.

3. Video from these cameras shall be sent to the TDC and TMC where it is made available to third parties over the Internet. However, during normal operational periods JPA staff shall have control over the pan, tilt and zoom camera features and Caltrans staff shall have only view access. During emergency situations, control of the video shall be provided to TMC staff.

4.5.1. CCTV Camera Locations

1. The CCTV cameras shall be installed at locations according to the preliminary plans.

4.5.2. CCTV Camera Requirements

1. The CCTV camera equipment shall include the following components:

- 1A - CCTV camera;
- 1B - Camera mounting pole;
- 1C - Pole foundation;

- 1D - CCTV control cabinet; and
- 1E - Video and communication components and cables.

2. CCTV cameras shall be able to turn 360 degrees and contain pan, tilt and zoom capabilities.

3. The CCTV subsystem shall use Ethernet-based communications and protocols.

4.6. SMART LANE ENFORCEMENT SUBSYSTEM

4.6.1. Smart Lane Enforcement Overview

1. The Smart Lane concept of allowing SOVs to pay a toll to utilize the additional capacity in the HOV lane adds a significant degree of complexity to system enforcement as compared to HOV lane enforcement. Enforcing the Smart Lane requires the CHP officers to determine if a toll was paid by the SOV driver and also to visually determine the number of occupants in the vehicle.

2. The high-level objective of the Smart Lane enforcement process is to provide fair and transparent enforcement which results in an acceptable level of Smart Lane use compliance and public acceptance.

4.6.1.1. Smart Lane Enforcement Process

1. The Smart Lane will be separated from the MF lanes by double solid lines with no physical barrier.

2. Drivers shall only be able to legally access the Smart Lane at designated access points marked with on-ramp and off-ramp striping.

3. Tolling zones shall be located just downstream from the Smart Lane entry point.

4. Smart Lane enforcement will be accomplished by CHP officers who are either parked in pre-designed enforcement areas, remotely from their moving patrol cars using Mobile Enforcement Readers (MER) or from their motorcycles using hand-held enforcement devices in conjunction with the beacons.

5. When a CHP officer observes an SOV in the Smart Lane, they will need to determine if the SOV driver has paid the toll and has a valid transponder. Accordingly, the officer shall require notification and confirmation from the tolling zone beacon and/or MER that the toll has been paid. This notification shall be provided within 1.0 second of the vehicle traveling through the tolling zone to allow the visual correlation of the SOV observation with toll payment indication.

4.6.1.2. System Enforcement Approach

1. There shall be two methods for providing notification to CHP officers that a Smart lane violation has occurred:

- 1A - Tolling Zone Beacon: The lane controller, which is located at the tolling zone, shall initiate a signal every time a tag read occurs when a transponder equipped vehicle traverses the tolling zone. The beacon shall illuminate each time a tag is read and it is determined to be a valid FasTrak™ transaction. This verification shall be made automatically by the lane controller by linking the transponder to the FasTrak™ account and confirming that it is an account in good standing. Therefore, if the beacon does not illuminate the SOV is suspected of being a violator. The CHP officer has the option to pull the vehicle over to determine whether the vehicle operator is attempting to violate the Smart Lane toll. If there is a transponder in the vehicle, the officer shall swipe the transponder across the top of a small hand-held transponder reader to determine whether their account is in good standing. If it is not, then a Smart Lane violation has occurred and the officer can take appropriate action.

- 1B - Mobile Enforcement Reader: The MER is a FasTrak™ antenna mounted on CHP patrol cars allowing an officer to determine whether passing vehicles are equipped with a transponder that is in good standing. The officers can either park on the shoulder of the road or be traveling along the corridor and query whether passing vehicles are equipped with a valid transponder or not by touching the screen of a Personal Digital Assistant (PDA) device which triggers an RF read signal. The MER antenna shall then attempt to detect a FasTrak™ on-board device and, if it does detect a tag, compares the antenna ID number against the tag status file that is resident on the MER to determine whether or not the transponder is linked to a good FasTrak™ account. A MER shall permit Smart Lane enforcement activities by CHP officers while traveling at highway speeds. Once the officer determines that a potential violator has been detected, he/she would pursue the suspected SOV violator and request that the driver pull over.

2. The PDA devices that are used in combination with the MER are a different type of unit than shall be integrated into the hand-held enforcement device.

4.6.2. Enforcement System Primary Requirements

1. The primary functions of each enforcement system component are discussed below.

- 1A - Toll Data Center: The TDC accepts the tag status and customer data from the BATA RCSC and is responsible for passing on this information to other components of the enforcement subsystem. Tag status information is transmitted to the lane controllers in each tolling zone on a periodic basis. Both tag status and customer descriptive data shall be downloaded to the MER's PDA device and the hand-held device over a high-speed connection.

- 1B - Lane Controller: As described previously, the lane controller shall be responsible for the monitoring and control of all equipment deployed at the tolling zones and for the transmission of FasTrak™ transactions to the TDC. For the enforcement subsystem, the lane controller, through the FasTrak™ reader, shall determine whether a read is valid and illuminate the beacon light if the read is good.

- 1C - Mobile Enforcement Reader: The MER shall determine whether passing vehicles are equipped with a transponder that is in good standing. The Officers can either park on the shoulder of the road or be traveling along the corridor and query whether passing vehicles are equipped with a valid transponder or not by touching the screen of a Personal Digital Assistant (PDA) device which triggers an RF read signal.

- 1D - Hand-Held Device: This unit shall allow the CHP officer to obtain account status information by waving the transponder across the top of the hand-held device. This will allow CHP motorcycle officers to enforce the Smart Lane.

4.6.3. Mobile Enforcement Reader

1. The MER shall allow CHP enforcement officers to confirm that an SOV is equipped with a transponder that is linked to an account that is in good standing.

4.6.3.1. MER Primary Functions

1. The MER shall provide the following functions:

   - 1A - The MER shall be able to read a transponder and determine whether it is in good standing or not.

   - 1B – The MER shall be able to read on-board transponders, at highway speeds, at distances of up to 75 feet.

   - 1C - The MER shall operate in compliance with the Title-21 FasTrak™ Dedicated Short Range Communications (DSRC) specifications, protocol and operating parameters.

   - 1D - The MER shall detect on-board transponders within the operating requirements that are used by the FasTrak™ readers and antennas that are installed at the Smart Lane tolling zones.

4.6.3.2. MER Equipment Requirements

1. The MER shall be weather proof, hardened for use outside and suitable for use by CHP enforcement cars.

2. The PDA display screen shall be visible under all lighting conditions.

3. Power to the MER antenna and reader shall be provided by the CHP vehicle's power source to ensure continuous use.

4.6.4. Handheld Enforcement Device

1. The hand held device shall allow the CHP motorcycle enforcement officers to confirm whether or not an SOV has a transponder that is linked to an account in good standing.

4.6.4.1. Hand Held Device Primary Functions

1. The hand held device shall provide the following functions:

- 1A - The hand held device shall be able to read a transponder and determine whether it is a linked to a FasTrak™ account that is in good standing; and

- 1B - The hand held device shall operate within the FasTrak™ Title-21 DSRC protocol and operating standards.

4.6.4.2. Hand Held Equipment Requirements

1. The hand held device shall be small enough in size, weather proof, hardened for use outside and suitable for use by a CHP motorcycle officer.

4.6.5. Enforcement Use of Personal Digital Assistant Devices

1. PDAs shall be used in support of both the MER and hand held enforcement devices.

2. The PDA shall provide CHP officers with readily accessible information on transponder identification numbers and related customer descriptive information.

3. The PDA shall also receive tag status downloads on, at least, a daily basis.

4.6.5.1. PDA Primary Functions

1. The PDA shall provide the following functions:

- 1A - The PDA shall receive tag status file data which includes the daily updated list of the valid and invalid transponders recognized by the BATA RCSC. This data shall be downloaded when the PDA is connected to the TDC Wide Area Network (WAN).

- 1B - The PDA shall receive tag status updates periodically throughout the day. This data shall be downloaded to the PDA over a secure, high-speed wireless communications connection.

- 1C - The PDA will contain software to compare a transponder's identification with the tag status file and determine if the transponder is linked to an account in good standing; and

- 1D - The PDA shall display information in an intuitive format that requires minimal interaction on the part of the user.

4.6.5.2. PDA Equipment Requirements

1. The PDA shall be small in size, weather proof, hardened for use outside and suitable for use by CHP motorcycle officers.

2. The PDA display screen shall be visible under all lighting conditions.

3. The PDA shall be able to receive data over a secure, high-speed, wireless WAN connection.

4. A rechargeable battery shall power the PDA that allows use for up to 12 hours of continuous use.

5. BATA REGIONAL CUSTOMER SERVICE CENTER

1. The existing BATA Regional Customer Service Center (RCSC) shall be slightly modified, by BATA's back office provider, to include Smart Lane functionality.

2. The current business rules, procedures and practices of the BATA RCSC shall remain the same, but some changes will be necessary to accommodate the new Smart Lane customers. One area in which changes will be required is to modify the BATA FasTrak™ account statements to include I-680 Smart Lane trips.

3. Other changes are required to integrate the Smart Lane operation into their back office processing, including agency codes, file names, etc.

5.1. INTERFACE TO THE JOINT POWERS AGENCY

1. The BATA RCSC shall allow a direct interface to the FasTrak™ account management, transponder tracking system, revenue transfers and other system reports to JPA staff, which will be located at the TDC.

2. When accessing customer accounts, JPA Customer Service Representatives (CSRs) shall be able to view Smart Lane transactions as well as account information.

5.2. RCSC SYSTEM REQUIREMENTS

1. The RCSC interface requirements in support of the Smart Lane shall be presented to the ETS Integrator in the form of the BATA RCSC Interface Control Document (ICD). This document shall be incorporated into the ETS RFP as an appendix.

5.3. SMART LANE CUSTOMER STATEMENTS

1. Current BATA FasTrak™ customer statements shall be modified to include actual Smart Lane trips that are made.

5.4. SMART LANE CUSTOMER AGREEMENT

1. The customer agreement required for obtaining a FasTrak™ account and transponder with the BATA RCSC shall be identical to joining the program as a user of the Caltrans toll bridges, the Golden Gate Bridge, etc.

6. SMART LANE COMMUNICATIONS NETWORK INFRASTRUCTURE

1. The Smart Lane Communications Network encompasses all communications between the devices in the field and the Tolling Data Center.

6.1 TOLLING ZONES TO TOLL DATA CENTER

1. Due to the distances between the Tolling Zones and the Toll Data Center (TDC), up to 26 miles, and the relatively high costs associated with adding new underground infrastructure, the communication links between the Tolling Zones and the TDC shall utilize either leased data communication services or a wireless communication network solution.

2. These communication links shall provide a minimum 1.5Mbps data rate and shall have a high level of availability (99.999%) in order to provide a reliable.

6.2. TOLLING ZONE TO TOLLING ZONE

1. Tolling Zone to Tolling Zone communication shall be used to provide a redundant or backup communications path to the Tolling Data Center should the primary communications path fail.

- 1A - Between the South and Central Tolling Zones this communication path shall be provided by a point to point WiMAX wireless link; and

- 1B - Between the Central and North Tolling Zones the redundant communications path shall utilize fixed wireless.

6.3 INTRA TOLLING ZONE

1. Intra Tolling communications is defined as the communications between the lane controller and the local field devices within the Tolling Zone. This includes the VDS, FasTrak™ antenna and reader, DMS and CCTV cameras.

- 1A - The coverage for any intra-TZ communications infrastructure is 0.5 mile per tolling zone.

- 1B - Secure point to point wireless communication links shall be used. For non-line-of-sight situations, repeaters shall be used.

- 1C - Where civil work is being undertaken within a Tolling Zone and it is practical to install underground infrastructure, twisted pair cabling shall be used for Lane Controller to field device communications.